# Evidence for early nasogastric tube removal after infrarenal aortic surgery: A randomized trial

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***Objective:*** **Nasogastric tube (NGT) decompression after abdominal surgery is still largely used to prevent nausea and vomiting. However, indications are based more on practice than on studies. Moreover, prolonged NGT decompression can lead to complications. In this prospective and randomized study, we evaluated the effects of early withdrawal of NGTs in patients undergoing surgery of the infrarenal aorta.**

***Methods:*** **Between October 2001 and May 2002, consecutive patients underwent scheduled infrarenal aortic operations. Patients were prospectively randomised into two groups: group 1, NGT maintenance until the passage of flatus; and group 2, NGT removal at the time of tracheal extubation. Preoperative and perioperative data were collected. The main end point was the occurrence of nausea and vomiting. Secondary end points were tolerance of NGT withdrawal and postoperative complications. Criteria were compared between groups by using Mann-Whitney or Fisher exact tests.**

***Results:*** **Forty-six patients underwent aortic operations. Six patients were subsequently excluded from the study. Of the 40 randomized subjects, 20 patients were included in each group. Preoperative and intraoperative data were similar in both groups. There was no statistical difference between groups regarding nausea and vomiting. In group 1, the occurrence of respiratory complications was more frequent compared with group 2 (5 vs 0 complications; $P = .023$). There was no significant difference in intensive care unit stay, but the hospital stay was shorter in group 2 (mean, 9 ± 3 days vs 15 ± 9 days; $P = .016$). There were no differences in other adverse events.**

***Conclusions:*** **This study does not support a significant effect of early removal of NGTs on nausea and vomiting in patients undergoing open repair of the infrarenal aorta. However, these findings suggest that NGT maintenance increases the risk of respiratory complications and the length of hospital stay. (J Vasc Surg 2005;42:654-9.)**

During the last 20 years, patients undergoing infrarenal aortic surgery have benefited from a significant reduction of perioperative morbidity and mortality.[1,2] The development of new surgical techniques and the improvement of perioperative management explain this phenomenon. However, certain treatment strategies are not based on studies, but rather on routine practices.

The postoperative course of abdominal laparotomy is marked by an inhibition of coordinated bowel activity, which causes an accumulation of secretions and results in digestive discomfort, abdominal distension, nausea, vomiting, and a stop of flatus per the rectum.[3] Postoperative ileus can develop after all types of abdominal surgery, including extraperitoneal surgery.[4] The accumulation of digestive secretions and air in the digestive tract can be responsible for wound dehiscence and negative interactions with respiratory function.[5,6] Treatment of postoperative ileus includes different types of resuscitation, such as correction of electrolyte disorders or nasogastric decompression. The initial purpose of nasogastric tube (NGT) use is to decompress the bowel after bowel resection and thereby reduce postoperative complications such as wound dehiscence, anastomotic disruption, aspiration, and wound infection.[6] Usually, an NGT is placed just after the induction of anesthesia and is maintained until the reappearance of passage of flatus per the rectum, at which point it is removed.

In 2002, to assess NGT use in France, we sent a questionnaire to 500 vascular surgeons (database from the Collège Français de Chirurgie Vasculaire). Vascular surgeons were asked to describe their NGT use during aortic operations. Among 252 responses, 10 (4%) did not mention their NGT use, 163 (65%) kept an NGT until resumption of intestinal function, 72 (28%) preferred early NGT removal, and 7 (3%) did not use an NGT during the perioperative period.

However, little scientific evidence supports the maintenance of NGT after laparotomy. A meta-analysis of selective routine nasogastric decompression after elective laparotomy for gastrointestinal and gynecologic surgery showed that a shortened NGT decompression was not associated with severe complications such as respiratory complications or anastomotic leaks.[5] However, NGTs could increase postoperative discomfort and the incidence of aspiration pneumonia and atelectasis.[7] Only one study has evaluated NGT withdrawal for aortic surgery.[8] This study showed no benefit for NGT maintenance, but neither postoperative nausea nor postoperative vomiting was an end point. These data led us to question the systematic need for gastrointestinal decompression via NGT after infrarenal aortic surgery.

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This prospective and randomized study evaluated shortened nasogastric decompression vs routine nasogastric decompression after open infrarenal aortic surgery. The occurrence of postoperative nausea and vomiting (PONV) was the main end point.

## PATIENTS AND METHODS

Between October 2001 and May 2002, consecutive patients referred to the University Hospital of Nantes underwent scheduled infrarenal aortic operations to treat abdominal aortic aneurysms or aortoiliac occlusive disease. This prospective and randomized study was approved by the local ethics committee (Comité Consultatif de Protection des Personnes dans la Recherche Biomédicale), and informed consent was obtained from each patient. Patients included in this study were older than 18 years of age. Excluded from this study were patients with previous esophagogastric or pancreatoduodenal surgery; gastroesophageal reflux, hiatal hernia, or both; swallowing difficulties; PONV; emergent surgery (ruptured abdominal aortic aneurysm); lack of preoperative bowel preparation; retroperitoneal approach; accidental intraoperative bowel injury; adhesiolysis for more than 1 hour; epidural anesthesia or analgesia; inhaled anesthetic use; intraoperative or postoperative metabolic disturbance (severe acidosis or hypokalemia); postoperative mechanical ventilation requirement for longer than 12 hours; or postoperative consciousness disorders (Glasgow score $<$ 10). Conventional techniques for open abdominal aortic surgery with a midline or transverse transperitoneal approach were used with evisceration in each case. A retractor was then gently placed to prevent the small bowel from entering the operating field.

**Anesthetic protocol.** A standardized protocol was used, to reduce bias. All patients underwent bowel preparation in the hypothesis of elective colonic surgery due to colonic necrosis after aortic surgery. Antibiotic prophylaxis was performed with cefazolin, cefuroxime, or vancomycin. Systemic heparin anticoagulation (50 U/kg) was intravenously administered at the time of cross-clamping. Hypnotics used for the induction of general anesthesia were propofol or etomidate, whereas thiopental was prohibited. Sufentanil was the only opioid used. Atracurium or cisatracurium was chosen as a muscle relaxant. Maintenance of anesthesia was obtained by associating propofol, sufentanil, and atracurium or cisatracurium. Authorized intraoperative treatments were hypotensive drugs (nicardipine or urapidil), vasopressors (ephedrine or norepinephrine), and inotropic drugs (dobutamine or dopexamine). Volume replacement was performed by crystalloids, colloids (gelatin or hydroxyethyl starch), or blood products. An NGT was placed after anesthetic induction, and its position was controlled surgically.

**Postoperative follow-up.** All patients were admitted to the surgical intensive care unit, where the NGT was removed or not at the time of tracheal extubation. Patients were prospectively randomized into group 1 (NGT maintenance until the passage of flatus) or group 2 (NGT removal at the time of tracheal extubation). During postoperative care, mean blood pressure was maintained between 90 and 110 mm Hg by using the intraoperative authorized treatment if necessary. For all groups, the following analgesic protocol was used: propacetamol (2 g/6 h intravenously) and intravenous morphine patient-controlled analgesia (1-mg bolus with a 7- to 15-minute lockout interval). Ulcer prevention was performed with histamine $H_2$-receptor antagonists. In case of nausea, vomiting, or both, dolasetron (12.5 mg intravenously) was used. If this failed (vomiting persisted for 10 minutes after infusion or was severe), then the NGT was replaced.

**Table I.** Baseline clinical characteristics

| *Variable* | *Group 1 (n = 20)** | *Group 2 (n = 20)†* |
|---|---|---|
| Age, y (mean ± SD) | 66.4 ± 11.1 | 63.9 ± 9.4 |
| Sex ratio (M/F) | 18/2 | 19/1 |
| BMI, kg/m$^2$ (mean ± SD) | 25.3 ± 4.0 | 27.1 ± 3.6 |
| BMI >27 kg/m$^2$ | 7 (35%) | 12 (60%) |
| Dyslipidemia | 13 (65%) | 11 (55%) |
| Hypertension | 15 (75%) | 13 (65%) |
| Smoker | 16 (80%) | 17 (85%) |
| Diabetes | 1 (5%) | 0 |
| Coronary artery disease | 11 (55%) | 6 (30%) |
| COPD | 5 (25%) | 3 (15%) |
| Arterial occlusive disease | 11 (55%) | 11 (55%) |
| Stroke | 2 (10%) | 1 (5%) |
| Heart failure | 3 (15%) | 1 (5%) |
| Alcohol abuse | 6 (30%) | 3 (15%) |
| Laparotomy history | 7 (35%) | 5 (25%) |
| Aortic pathology | | |
| AOD | 10 (50%) | 10 (50%) |
| Aneurysm | 10 (50%) | 10 (50%) |
| Aneurysm diameter, mm (mean ± SD) | 54 ± 5 | 60 ± 10 |

*BMI,* Body mass index; *COPD,* chronic obstructive pulmonary disease; *AOD,* aortoiliac occlusive disease.
Data are n (%) unless otherwise noted.
*Group 1 included patients with prolonged gastric decompression.
†Group 2 included patients with early removal of the nasogastric tube.

**End points.** The main end point was the occurrence of PONV. Secondary end points were passage of flatus per rectum, tolerance of NGT removal or maintenance, and postoperative complications. Baseline clinical characteristics and intraoperative data were collected in a computerized database.

**Statistical analysis.** End points were expressed as absolute values or percentages. Other data were expressed as mean ± SD. Statistical analysis used the Mann-Whitney test for non normally distributed continuous variables and the Fisher exact test for categorical data. $P < .05$ was considered significant.

## RESULTS

The study population consisted of 46 consecutive patients undergoing open operation of the infrarenal aorta between October 2001 and May 2002. Among them, six patients were excluded because of emergent surgery (three patients), gastroesophageal reflux (one patient), request for epidural analgesia (one patient), and requirement for post-

**Table II.** Intraoperative data according to removal of the nasogastric tube

| *Variable* | *Group 1 (n = 20)** | *Group 2 (n = 20)†* |
|---|---|---|
| Operation duration, min (mean ± SD) | 177 ± 58 | 179 ± 67 |
| Cross-clamping duration, min (mean ± SD) | 62 ± 21 | 68 ± 32 |
| Cross-clamping type | | |
| Infrarenal | 18 (90%) | 16 (80%) |
| Interrenal | 0 | 1 (5%) |
| Suprarenal | 2 (10%) | 3 (15%) |
| Intraoperative blood loss, mL (mean ± SD) | 1488 ± 855 | 1324 ± 878 |
| Temperature at the end of the procedure, °C (mean ± SD) | 36.4 ± 0.6 | 36.3 ± 0.5 |

Data are n (%) unless otherwise noted.
*Group 1 included patients with prolonged gastric decompression.
†Group 2 included patients with early removal of the nasogastric tube.

**Table III.** Postoperative data

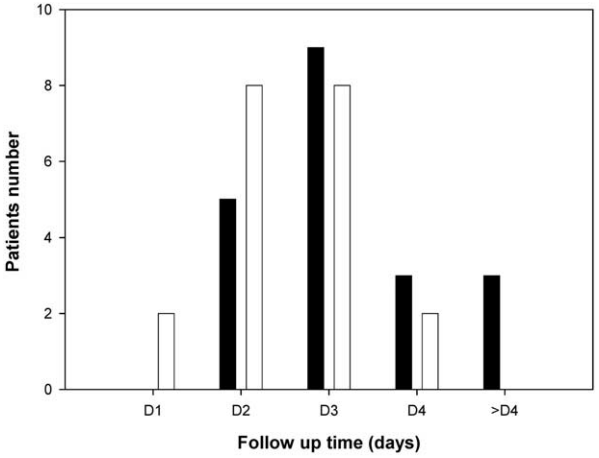
| *Variable* | *Group 1 (n = 20)** | *Group 2 (n = 20)†* | P *value* |
|---|---|---|---|
| Vomiting | 3 (15%) | 2 (10%) | NS |
| Nausea | 3 (15%) | 3 (15%) | NS |
| Tube replacement | 2 (10%) | 1 (5%) | NS |
| Morphine consumption, mg/d (mean ± SD) | | | NS |
| Day of operation | 12.4 ± 7.0 | 18.3 ± 8.7 | |
| First day after operation | 23.4 ± 18.9 | 24.0 ± 32.4 | |
| Second day after operation | 8.5 ± 12.5 | 9.4 ± 12.0 | |
| SAPS II | 20.7 ± 5.3 | 19.4 ± 6.4 | NS |
| Morbidity | | | |
| Respiratory complications | 5 (20%) | 0 | .023 |
| Laryngeal trauma | 1 (5%) | 0 | NS |
| Atrial fibrillation | 2 (10%) | 0 | NS |
| Hematemesis | 1 (5%)° | 0 | NS |
| Functional renal failure | 1 (5%) | 0 | NS |
| Mortality | 1 (5%) | 0 | NS |
| Reintervention | 0 | 1 (5%) | NS |
| Length of ICU stay, d (mean ± SD) | 4.2 ± 7.4 | 1.1 ± 0.4 | NS |
| Length of hospital stay, d (mean ± SD) | 15 ± 9 | 9 ± 3 | .016 |

*NS,* Not significant; *SAPS II,* simplified acute physiology score; *ICU,* intensive care unit.
Data are n (%) unless otherwise noted.
*Group 1 included patients with prolonged gastric decompression.
†Group 2 included patients with early removal of the nasogastric tube.

operative mechanical ventilation for more than 12 hours (one patient). Surgical repairs included 20 aortic aneurysms and 20 aortoiliac occlusive diseases. The two groups were well matched for baseline clinical characteristics (Table I). Nine and seven patients had a previous history of laparotomy in groups 1 and 2, respectively. The distribution of abdominal aortic aneurysm or aortoiliac occlusive disease operations was not different between groups. The mean aneurysm diameter was equivalent in the compared groups. Intraoperative data were similar in both groups (Table II).

Complete follow-up data and treatment assignment were available for all patients (Table III). The vomiting incidence rate was 10% (n = 2) in group 2. One patient had vomiting associated with diarrhea 2 days after surgery. Endoscopic investigations did not reveal any digestive etiology. Symptoms resolved spontaneously. For the second patient, the operative course was characterized by major bleeding (3400 mL) and cardiovascular instability. Vomiting occurred immediately after tracheal extubation, although hemodynamic variables were stabilized. No tube replacement was necessary. No difference in vomiting was observed between groups. In group 1, one patient had an isolated vomiting episode after refeeding, with spontaneous resolution. The other two patients were a woman with NGT intolerance and an obese man. In both cases, despite early passage of flatus and tube removal, resistant vomiting after medical treatment occurred, and nasogastric decompression was reintroduced for 48 hours.

Nausea rates were comparable in both groups. In addition, the tube-replacement rate, morphine consumption, and resumption of flatus were equivalent in both groups (Fig 1 and Table III). In our trial, three patients had serious complications. The first patient had serious pneumonia that required reintubation 8 hours after extubation. The identified germ was methicillin-resistant *Staphylococcus aureus* and, considering the early symptoms, was probably related to two previous hospitalizations in the intensive care unit. The second patient had a history of chronic obstructive




Bar graph shows the number of patients with first flatus after operation of the infrarenal aorta at 1, 2, 3, 4, and longer than 4 days after surgery. No significance could be found between groups. *Solid bars* indicate patients with prolonged nasogastric tube maintenance; *open bars* indicate patients with early removal of the nasogastric tube.

pulmonary disease and developed pneumonia that necessitated reintubation at 2 days. The germ was *Haemophilus influenzae*. Both patients were discharged at 34 days. The third patient had occlusive aorta disease and concomitant ischemic heart and renal artery disease. He was treated for serious pneumonia that required reintubation 2 days after extubation. One day later, he presented with septic shock, and despite resuscitation measures, he subsequently died of cardiac failure. The identified germs were *Haemophilus influenzae* and *Escherichia coli*. All of these patients belonged to the same group (group 1), as did the other patients with moderate respiratory complications (one moderate pneumonia and one atelectasis).

Statistical analysis revealed a significant difference between groups regarding the occurrence of postoperative respiratory complications ($P = .023$). Furthermore, compared with patients undergoing early NGT removal, those with prolonged gastric decompression had a longer hospital stay ($9 \pm 3$ days vs $15 \pm 9$ days; $P = .016$). The stay in the intensive care unit was also longer in group 1, but the difference was not significant ($4.2 \pm 7.4$ days vs $1.1 \pm 0.4$ days; $P = .16$).

## DISCUSSION

This study was a prospective randomized trial that compared shortened nasogastric decompression vs routine nasogastric decompression after open infrarenal aortic surgery. We showed that the resumption of intestinal function was identical between groups. The incidence of PONV was not different between the two patient groups, and both groups were comparable in terms of passage of flatus. It is interesting to note that we showed a significant difference between groups regarding postoperative complications, with a significant trend toward fewer respiratory complications in the group with early NGT removal. Finally, the hospital and intensive care unit stays were shorter in the group with early NGT withdrawal.

This study has several limitations. The main limitation is the small sample sizes, which do not provide sufficient statistical power to be conclusive. However, our results are consistent with those of previous studies[5,8] and particularly with those of a recent meta-analysis.[9] Another deficiency was design faults such as failing to report retroperitoneal hematoma, hemodynamic instability, or intraoperative volume overload, which are associated with bowel edema and consequent ileus.

Several criteria influence the resumption of intestinal function after elective laparotomy. First, surgical techniques can allow a reduction of bowel mobilization and, thus, a decreased incidence of ileus. For example, procedures for aortic surgery—such as minimal incision and retroperitoneal and, more recently, laparoscopic approaches—can reduce bowel manipulation by maintaining it within the abdominal cavity.[10-12] Furthermore, the absence of evisceration is known to significantly decrease the incidence of hypothermia and blood loss and, thus, to improve the postoperative course.[13] However, reports are contradictory regarding the relationship between the duration of the operative procedure or blood loss and the resumption of intestinal function.[14,15] Other methods have been developed to reduce postoperative ileus. One study reported that multimodal rehabilitation for open or laparoscopic colonic surgery with epidural analgesia, early oral nutrition and mobilization, and laxative use decreased the duration of ileus to approximately 2 days.[16] In our study, epidural local anesthetics were avoided. Indeed, we consider that anticoagulant and antiplatelet agents that are commonly prescribed in patients undergoing operation of the infrarenal aorta could compromise the safety of epidural catheters related to the potential occurrence of epidural hematoma.[17] Some authors have noted that rapidly progressing to a liquid diet after the development of bowel sounds does not foster postoperative ileus and, thus, have suggested that the duration between the development of bowel sounds and the start of a liquid diet was a possible independent predictor of postoperative ileus.[18] Other authors have suggested that early feeding via the NGT should be performed after surgery to decrease the need for intravenous solutions and, possibly, to allow earlier discharge.[19] However, in a study to define jejunal manometric and small-bowel transit, the authors predicted a high rate of enteral feeding intolerance early after surgery because of impaired function of the jejunum and the small bowel.[15]

To assess whether early NGT removal was well tolerated and safe, we first looked at the resumption of PONV with and without early NGT removal. Our study did not show any significant difference between groups in terms of PONV. In the single study that evaluated early NGT withdrawal after aortic surgery, PONV was not among the end points. In the same study, there was no difference between groups regarding the resumption of the liquid and solid diet. The Cheatham meta-analysis of NGT use after elective

laparotomy included 20 studies and 2915 patients and showed that early NGT withdrawal was associated with a significantly higher rate of vomiting (relative risk, 1.45; $P = .005$) and of abdominal distension (relative risk, 0.38; $P = .02$). However, NGT reinsertion was required in only 5% to 7% of patients, which is similar to our findings. It should be noted that in this meta-analysis, the duration of postoperative ileus was not among the end points.

Three approaches are recommended to control PONV symptoms. First, the reduction of PONV risk includes regional anesthesia, propofol for induction and maintenance of anesthesia, intraoperative supplemental oxygen, hydration, and minimization of intraoperative and postoperative opioids.[20] Use of volatile agents was avoided because they could be the leading cause of early postoperative vomiting.[21,22] Similarly, the maintenance of blood pressure has been shown to exert an antiemetic effect.[23] Second, antiemetic therapy for PONV prophylaxis can be used. This type of treatment has considerably changed since the early 1990s with the introduction of new drugs such as serotonin receptor antagonists (specifically the 5-hydroxytryptamine 3 subgroup). Older antiemetics (eg, dexamethasone, droperidol, scopolamine, and phenothiazine) are also effective for preventing PONV; however, some of them are associated with adverse effects.[20] Moreover, multimodal management that includes antiemetic and specific anesthetic regimens seems to be more effective than monotherapy prophylaxis.[24] Finally, the recommended approach is to wait and treat only if necessary. Indeed, little evidence exists for the efficiency of antiemetics for treatment of established PONV as opposed to prophylaxis.[25] Nevertheless, there is evidence for the efficiency of 5-hydroxytryptamine 3 receptor antagonists.

Some authors have created scores or models to determine which patients need antiemetic prophylaxis or therapy. Apfel et al[26] created a simplified risk score, identifying four primary risk factors: female sex, nonsmoking status, history of PONV, and postoperative opioid use. The incidences of PONV with the presence of zero, one, two, three, or all four of these risk factors were approximately 10%, 20%, 40%, 60%, and 80%, respectively. According to this score, our patients presented one risk factor (postoperative opioid use) in most cases; this corresponds to a 20% risk. Surprisingly, Apfel et al found that the type of operation was not an independent risk factor for PONV. Other studies included as risk factors youth, duration of operation (each 30-minute increase in duration increases PONV risk by 60%), type of operation (laparotomy is considered as a risk factor), and type of anesthesia.[27] With this last guideline, at least two risk factors (laparoscopy and opioid use) were present in our patient population, thus leading to a mild to moderate risk (20%-40%).

We showed a trend toward fewer respiratory complications in the group with early NGT removal. First, this finding is consistent with previous reports that have already shown a higher risk of respiratory complications in the group with prolonged NGT maintenance.[5,28] Second, although patients could have pre-existing conditions and concomitant comorbidities, randomized trials ensure balance in preoperative risk factors between groups. Indeed, no statistical difference was noted in terms of preoperative risk factors. In our study, the length of hospitalization seems to favor early NGT removal. This result is consistent with previous reports after gastrointestinal surgery in which the length of hospital stay was shortened by approximately 1 day in the group without early NGT removal.[9,18] However, we may assume that the larger difference observed in our trial is due in part to the fact that two patients had severe postoperative complications (the hospital stay was 34 days for both). Finally, a shorter hospital stay probably reduces hospital costs.

In conclusion, the absence of a significant difference between groups in terms of resumption of intestinal function and postoperative complications should encourage early removal of the NGT. The postoperative course must include adapted analgesia and medical resuscitation to improve the tolerance of early NGT removal.

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